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COMMONWEALTH PHYTOPATHOLOGICAL NEWS

A QUARTERLY REVIEW OF NEWS AND VIEWS ISSUED BY THE COMMONWEALTH MYCOLOGICAL INSTITUTE, KEW, SURREY

MAIN ITEMS

SPRAYING AGAINST CACAO BLACK POD

CONTROL OF ENVIRONMENT

NEW COTTON ROOT ROT

STOLBUR COMPLEX

PERSONAL NEWS

OVERSEAS NEWS

NEAR AND FAR

SPRAY TECHNIQUES: BLACK POD CONTROL IN NIGERIA COCOA FARMS

C.A. Thorold, Officer in Charge, Woburn Experimental Station, Beds., formerly Principal Research Officer, Department of Agricultural Research, Nigeria

The enthusiasm shown by Nigerian cocoa farmers in the control of black pod disease by spraying has been such as to prompt the comment by Mr. A. Viton (CACAO FAO COMMODITY SER. BULL. 27, p. 28, 1955) that 'Every European concerned with cacao commented on this in 1954.'. The interest of many farmers had been aroused by satisfactory control of the disease through applications of carbide-Bordeaux, carried out by the Department of Agriculture in the period 1950-54. In addition to these demonstrations several other factors have contributed to the rapid development of spraying, which has necessitated large-scale importations of spray-pumps, rising from 2,000 pumps in 1953 to 8,000 in 1956.

Enthusiasm Among Africans

Influential Africans have shown much interest in black pod control measures, as exemplified in fig. 1, which shows cocoa spraying being demonstrated to the Oni of Ife, who on this occasion himself operated one of the pumps. Strong Government support has provided substantial impetus. Sir John Rankine spoke as follows at the opening of the third session of the Western Regional Legislature, 'My Government attaches great importance to the campaign against black pod disease..... The Finance Corporation will continue to assist with the offer of credit facilities to the cocoa farmers'.

Although many of the cocoa farms are small (frequently about one acre) with the trees closely and irregularly spaced, as shown in fig. 2, these circumstances have not been entirely disadvantageous. Most of the pods are borne on the main trunk; because there are few low branches, this tree habit facilitates fungicide applications. However, the fact that some pods are borne high up in the canopy has meant that

Fig. 1. An instructor demonstrating cocoa spraying to the Oni of Ife (Photograph Western Region Information Service)

such pods may escape spray protection through being out of reach of normal hand operation. It has been noted that certain farmers circumvented the limited reach of conventional pressures and nozzles by removing the swirl plate, so that high pods received a jet of spray from the pump. It is explained later that power spraying may provide satisfactory means of applying fungicide to pods at all levels.

It seems that farmers have co-operated in the use of sprayers because it was estimated that the 1,154 sprayers operated in 1954, covered over 12,000 acres, an average of about 11 acres per pump, whilst the average acreage per farmer is much less than 11 acres. Although much importance is attached to the training of farmers in the technique of spraying it is evident that ingenuity and initiative were shown by individuals. On one occasion a farmer who had only a few cocoa trees and apparently no spray-pump was applying carbide-Bordeaux to his pods by means of a paint-brush.

Spraying Economics

It is generally impossible to obtain from farmers details regarding the amount of cocoa sprayed and the benefits which accrue. However, reliable information on production was available in the cases of farmers who sold their cocoa through registered co-operative societies. Eleven farmers, who are members of the Aponmu-Akure Co-operative Society, sprayed their farms in two seasons (1954-55 and 1955-56). It is interesting to compare the amounts of cocoa obtained in these two seasons with the production in the two previous seasons, when no spraying was done.

There were apparent differences in favour of spraying, ranging from 50 to over 300 per cent. It is not known whether these differentials were entirely due to fungicide applications, but it is unlikely that such large increases were seasonal or merely fortuitous, because total production in Ondo Province in the two seasons 1954-56, exceeded total production in 1953-54 by only about 11 per cent. as shown below.

Cocoa production in Ondo and Ibadan Provinces in two seasons (mean of 1952-53 and 1953-54) compared with production in the two following seasons (mean of 1954-55 and 1955-56).

Province	1952-54	1954-56	Difference expressed as per cent. of 1952-54 mean
Ondo	18763·5 (tons)	20838·0 (tons)	+ 11·1
Ibadan	28462·0 (")	26263·5 (")	- 7·7

In the absence of detailed information regarding the acreage and production of sprayed farms in Ondo Province in 1954-56 it is a matter of speculation whether some of the apparent increase (+ 11·1 per cent.) was due to black pod control. However, it is noteworthy that in the neighbouring Ibadan Province, where little or no spraying was done, production was less (- 7·7 per cent.) in 1954-56 as compared with 1952-54.

Government Trials

The Nigerian cocoa grower is no exception in the possession of the proverbial reluctance, or apparent inability, of farmers to provide precise information on the economics of their enterprises. Although costs are known from official spraying trials carried out on farms these costings are not necessarily applicable to the Nigerian cocoa industry in general, because labour and supervision cost items are somewhat fictitious under peasant farming conditions. On account of such 'overheads' as spray pumps spraying costs are affected by the extent and productivity of the area to be treated. On the basis of a trial carried out by the Department of Agriculture, when 40 acres of farmers' cocoa was sprayed at a cost of about £17 per acre (12 applications), it seemed that when the farmer could expect £170 per ton for his cocoa it might be economical to spray in a relatively bad black pod area (at least 50 per cent. loss), if the potential yield was 12 or more pods per tree (or, say, 600 lb. dry cocoa per acre (worth £45). The gross profit should then be £28 (£45 - £17). On the other hand, with a production of 400 lb. per acre (worth £30), spraying might not be economic, because the gross profit (£13) is less than might have been obtained without spraying (200 lb. cocoa worth £15).

Reducing Costs

Much cocoa in Nigeria is relatively low yielding (300 lb. to 400 lb. per acre), it was also to be expected that there would be a decline in the price which the farmer obtains for his cocoa. Attention has been given, therefore, to possible ways in which spraying costs can be reduced. Recent trials have shown that 0·4 per cent. perenox is similar in cost and almost as effective as 1 per cent. carbide-Bordeaux. Perenox is easier to mix and apply. There is also the advantage that buckets and pumps do not deteriorate as rapidly with perenox as they do when copper sulphate is being used. In 1956-57, a trial was carried out in which 1 per cent. carbide-Bordeaux and 0·4 per cent. perenox were applied by normally operated spray pumps, whilst the 0·4 per cent. perenox was also applied by a power-operated knapsack machine ('Motoblo') in order to observe whether efficient control could be obtained when fungicide is applied to the trees in this way. Spraying costs were recorded and the results obtained in this trial show relatively good disease control (17·4 per cent. black pods) and relatively low cost (£4·1) to have been associated with power-spraying, but confirmatory tests are desirable. Some farmers had been favourably

(continued on p. 39)

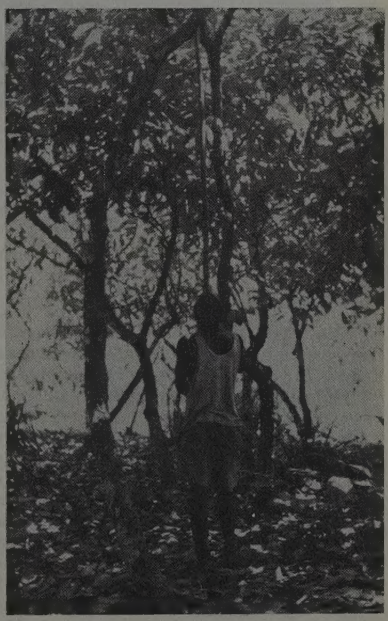


Fig. 2. A typical Nigeria cocoa farm, showing closely and irregularly spaced trees. Pods borne on the main stems, but some high up in the canopy. (Photograph Western Region Information Service.)

STOLBUR AND SIMILAR DISEASES

J.M. Todd, Scientific Services, Department of Agriculture for Scotland

(Continued)

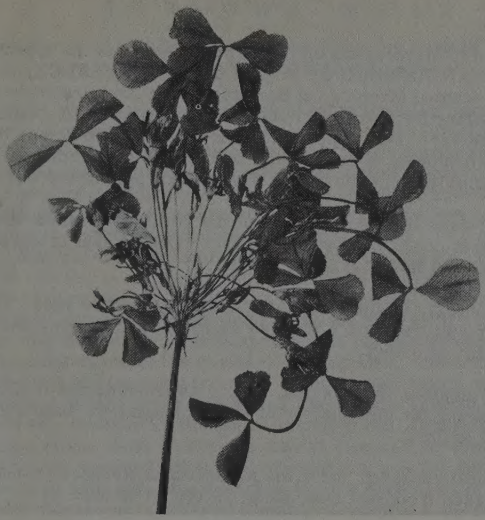
A disease cycle like that of stolbur gives plenty of scope to the plant protectionist and appropriate agronomic adjustments to mitigate the effect of Hyalesthes obsoletus were discussed at the conference. These included increasing the density of planting, planting earlier or later than usual (to escape the peak period of migration),

Smolenice Castle - a centre for scientific conferences in Slovakia

use of insecticides, and weed control. A change in land usage would also seem to have some relevance because the annual proportionate loss due to stolbur must be materially affected by the customary division of the land into very many small narrow plots.

Virus Disease of the Yellows Type

Biologically, the most interesting discussion during the conference concerned the extent and interrelationships of diseases of the yellows type. In Czechoslovakia, the yellows diseases of herbaceous plants fall into three categories: (1) classical stolbur (sometimes referred to as "southern stolbur"), (2) potato witches' broom (or "northern stolbur"), and (3) largely undifferentiated diseases, of which bud proliferation, phyllody, and virescence are general symptoms. The continuing problem is, of course, to discover how many distinct viruses are involved under the third head. For instance, classical stolbur can cause a convincing yellows disease in asters (Valenta, 1956), as also can European aster yellows (Heinze and Kunze, 1955). What is the relationship of these viruses to each other and to American aster yellows? Already over a hundred species of plants have been noted in Czechoslovakia with symptoms of phyllody, virescence, etc. Some such instances have been shown to pertain to stolbur, but not a few occur outside the normal range of stolbur disease in crop plants. An imposing list of plants with yellows symptoms had also been recorded from Russia (Sukhov and Vovk, 1945). Again what are the interrelationships? Slovak potato witches' broom virus causes marked phyllody or virescence in many solanaceous test plants, and Japanese potato witches' broom virus is known to occur naturally in some leguminous plants, causing prolferation. But the witches' broom diseases of potato in different parts of the world are mostly somewhat distinct and certainly the Slovak and Scottish forms are not the same.



Phyllody in white clover, Northern Slovakia.

Is there a range of viruses in the natural floras of the world which can cause symptoms of rather restricted types in specific plants, such as "purple top" and "witches' broom" in potato, "big bud" in tomato and "yellows" in aster?

Future Virus Research

If one leaves aside the agronomic aspects, which are of immediate concern in the separate countries, the yellows group of diseases presents virologists with fundamental problems concerning their origin, epidemiology, and specific etiology. They appear to be particularly associated with the continental land masses of the temperate zones, and here in Great Britain we may not have quite the same opportunities to tackle them as have research workers elsewhere; nevertheless diseases like nettlehead, potato witches' broom, rubus stunt, and strawberry green petal show that opportunities do exist.

Considering the size of the country Czechoslovakia is likely to do well in research of this nature. Plant pathology there seems to have a strong bias towards virus work and much of the latter is presently devoted to stolbur and similar diseases. There are two main centres for fundamental work, the Department of Phytopathology of the Biological Institute, Prague, and the Institute for Virology, Bratislava; both come under the Czechoslovak Academy of Science. The Institute for Virology is a splendid new establishment in which the economy is practised of having research in all the main branches of virology brought together under the same roof.

Slovakian potato witches' broom a few months after inoculation. In the same time Scottish witches' broom would hardly show. (The tendrils are dodder.)

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FROM NEAR AND FAR

Of considerable importance to mycologists and plant pathologists is the appearance of a new periodical the INDIAN JOURNAL OF MYCOLOGICAL RESEARCH, the official organ of the newly formed Mycological Society, whose first president is Prof. S.R. Bose, of the Botany Department, R.G. Kar Medical College, Calcutta; the editor is Dr. S.N. Banerjee. This appears to be a natural and welcome development of the interest in mycology shown by so many scientists in India, and should greatly add to our knowledge of the fungus flora of that part of the world.

The occurrence of sugar-cane leaf scald Xanthomonas albilineans in Martinique, British West Indies, has been confirmed by J.A. Spence, Department of Agriculture, Trinidad and Tobago, in a mimeographed report.

Kumasi College of Technology, Ghana, was inaugurated in October 1956. It now possesses a Faculty of Agriculture, with a 30-acre experimental station, and is appointing a lecturer in plant pathology.

The National Science Foundation, Washington, D.C., awarded grants totalling over 13,850,000 dollars during the last quarter of 1956, bringing the total awards since 1951 to nearly 50 m. dollars.

Expenditure on agricultural research under the Agricultural Research Council of Great Britain has increased from just over £2 m. in 1950-1 to over £4 m. in 1955-6.

Books of Interest

Kenneth Smith's second edition to his well known TEXTBOOK OF PLANT VIRUS DISEASES covers an enormous ground and contains most necessary information for the plant pathologist. It indicates how far the science had advanced in the last twenty years (J. & A. Churchill, Lond. vi + 652. 65s.).

L. Broadbent's report on INVESTIGATIONS OF VIRUS DISEASES OF BRASSICA CROPS is full of interest for the working virologist. As well as the experimental results recorded it includes practical instruction for testing (Agric. Res. Coun. Rep. Ser. 14. vii + 94 pp. 15s.).

The first BULLETIN OF FOREST PATHOLOGY IN NEW ZEALAND (N. Z. For. Ser. 62 pp., Govt. Printer, Wellington, 1955) deals with insect pests and fungal diseases.

The second edition of Dowson's MANUAL OF BACTERIAL PLANT DISEASES was published by Cambridge University Press in June, price 32s. 6d.

Antibiotical Quotes on Streptomycin

'The structures of the three parts of this molecule are all equally irrational: the mere idea that nature has fitted these units together to form a molecule with a remarkably specific action tends to depress the most modest among biologists'
— Sir Harold Hartley.

.....'it [the formula] can most aptly be described as the product of an organic chemist just before his admittance to a lunatic asylum' — Prof. Kluyver.

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ABYAN ROOT ROT OF COTTON

[A fuller report will be published shortly in the Empire Cotton Growing Corporation Reports from Experiment Stations, Aden Protectorate. Ed.]

Dr. G.M. Wickens, of the Empire Cotton Growing Corporation Cotton Research Station, Namulonge, Uganda has commenced investigation in the Aden Protectorate of a cotton disease which is characteristically a root rot. In order to avoid misconception through confusion with other known diseases of cotton of both vascular wilt and root-rotting types this disease should be known for the present simply as "Abyan root rot". A record of Fusarium [oxysporum f.] vasinfectum as being implicated is improbable and should be discounted. One or more species of Rhizoctonia may possibly be implicated, but there is as yet no proof of this.

The disease occurs sporadically in roughly circular patches, commonly up to 10 yards in diameter, in which all plants are killed extremely rapidly. On one day a plant may appear perfectly healthy; on the next all its leaves may be withered or dead: the disease tends to reappear with further extensions.

The outer layer of the cortex of the tap root, and sometimes of the laterals, is papery and is separated from the inner cortex which has a shredded appearance, consisting of long separated fibres. In plants recently collapsed these symptoms extend into the base of the stem; in plants still apparently healthy, at the edges of affected sites, these symptoms may be found in the lower parts of tap roots, but have not yet reached the region of emergence of the main laterals. It seems a reasonable inference that infection occurs deep down in the soil, and that rapid upward movement of cortical disintegration of the tap roots leads to the characteristic rapid leaf collapse. Discolouration of the cortex and outer layers of the xylem of affected roots and stem bases is variable; either vivid yellow, or carmine, or reddish brown, or brown.

These symptoms, and the general behaviour of the disease, agree closely with the description by Saccas of a disease of cotton in French Equatorial Africa, which was attributed by him to Olpidiaster gossypii. This claim was, however, based solely on his microscopic observation of the fungus in diseased tissues and its isolation on a special medium. The generally acceptable evidence of pathogenicity was not recorded as having been obtained.

The symptoms and behaviour agree closely also with those described for a widespread and destructive root rot of cotton in West Pakistan, which Vasudeva, on the basis of results of inoculations with fungi isolated from diseased roots, ascribed to a strain of Rhizoctonia solani and to ?R. bataticola (Macrophomina phaseoli). Later work, such as that by Inamullah Khan, has failed to demonstrate that these fungi are pathogenic to cotton "under normal soil conditions". Here also conclusive proof of the cause of the disease seems to be lacking.

A very similar disease was seen in a number of other crops grown in the Abyan scheme, although the vivid colouration of diseased tissues commonly seen in infected cotton was generally absent.

The Abyan Scheme is thus faced with a destructive cotton disease of unknown cause. It has the appearance of being due to a parasitic organism (or organisms), possibly catholic in host range, that is highly virulent under certain, perhaps rather critical, soil condtions. Essential facilities are being provided for further work in Aden, which will be undertaken by C. Logan of the Plant Pathology Section, Namulonge, during next season.

(continued from p. 35)

impressed and were considering the importation of similar equipment. It is likely to be of great advantage if power-sprayers can be successfully operated under peasant farming conditions for black pod disease control because there will be scope for use of this equipment also for control of the capsid pest of cocoa. In the speech referred to above, Sir John Rankine foreshadowed this further development in cocoa amelioration; 'The Department of Agriculture will also turn its attention to methods of controlling capsid damage. 3,000 acres of capsid infested cocoa in different parts of the Region will be subjected to spraying experiments.' The enthusiasm shown by farmers for black pod control augers well for the adoption of the technique of capsid control also, with the probability of more economical use of equipment if it can be employed for the dual purposes of pest and disease control.

P E R S O N A L N E W S

Visitors to C.M.I.

Among overseas visitors were V. Armstrong, New Zealand; J.E.C. Coventry, S. Rhodesia; D.J. Harrison, Guernsey; R.N. Hilton, R.R.I., Malaya; Dr. W.R. Hudson, Australia; Prof. J. Mirhij, Beirut University, Lebanon; R.L. Munjal, I.A.R.I., New Delhi, and Dr. P. Nandi, Bose Institute, Calcutta, India; C. Orieux, Mauritius; R.A. Robinson, Kenya; Dr. Gabriel Segretain, Pasteur Institute, Paris; A. Thompson, Singapore.

Prof. H. Braun and Dr. C. Mortini, Institut Pflanzenkrankheiten, Bonn, Germany, brought a party of students.

Appointments, Promotions, Retirements etc.

The Overseas Service Department of the Colonial Office announce the following appointments: A.A. Brunt, plant virologist, WACRI, Ghana; J.K. Cox, assistant director of agriculture, N. Borneo; M.A.G. Hanschell, director of agriculture, British Honduras; Dr. T.W. Tinsley, deputy director, WACRI, Nigeria.

Dr. G.C. Ainsworth has been appointed an assistant editor at the C.M.I. and takes up his duties in August 1957.

Drs. J. Edelman and Helen K. Porter have been appointed university readers in plant physiology and enzymology, respectively, at the Imperial College of Science and Technology, London, and Dr. I.W. Selman, as reader in agricultural botany at Wye College.

Dr. Franklin Kidd, F.R.S., has retired from the Food Investigation Organisation after nearly 40 years service. He is well known for his researches on the gas storage of fruit at Ditton Laboratory.

Sir William Ogg, director of Rothamsted Experimental Station, has been elected an associate member of the All-Union Academy of Agricultural Sciences in U.S.S.R.

The Duke of Northumberland has been appointed chairman of the Agricultural Research Council of Great Britain in succession to Lord Rothschild, who retires after 10 years service.

Royal Society: Sir Ewart Smith, deputy chairman and technical director, I.C.I., Prof. F.C. Steward, professor of botany, Cornell University, U.S.A., and Dr. A.S. Watt, lecturer in botany, Cambridge University, have been elected Fellows of the Royal Society.

Royal Edinburgh Society: The following have been elected Fellows - Prof. J.H. Burnett, professor of botany, St. Andrew's University, Dr. W.A. Clark, department of botany, King's College, Newcastle, and Dr. J.W. Gregor, director, Scottish Plant Breeding Station.

Association of Applied Biologists: Dr. W.P.K. Findlay has been elected president and G.G. Samuel vice-president for 1957-8.

Award

An honorary doctorate of the University of Uppsala was awarded to Dr. J. Ramsbottom at the Linnaean celebrations held recently.

OBITUARY

The death is regretfully recorded of Sir John Simonsen, F.R.S., formerly director of the Colonial Products Research Laboratory.

OVERSEAS NEWS

NOTES FROM CANADA

Two reports of recent research in Canada are reviewed below on account of their intrinsic interest.

Verticillium Wilt or Leaf Mottle of Sunflower: The leaf mottle disease of sunflowers, which was first observed by W. E. Sackston in Manitoba in 1948 (CAN. PLANT DIS. SURVEY REPT. 28, 32, 1949) has since caused considerable loss in some years. Recently the causal organism was shown to be Verticillium albo-atrum.

The fungus was isolated consistently from diseased plants collected in farm fields and from sunflowers grown in pots of soil from fields showing the disease in 1955. Severe stunting, wilting, and premature killing resulted from inoculation of the roots of seedling transplants in the greenhouse. Typical leaf mottle symptoms were reproduced in the greenhouse when older plants were inoculated by injecting spore suspensions of the fungus into the stems and petioles. The disease is very similar in symptomatology to Verticillium wilt of cotton. Crop rotation appears to be the only method of control available. All the severely diseased fields observed during a survey made in August 1956 had been previously planted to sunflowers within the past three years. Recommendations have been made to growers that they avoid growing potatoes, tomatoes, or sunflowers within 4 years on land previously cropped with any of these crops.

The observations are reported in a paper by W. E. Sackston, W. C. McDonald, and John Martens in the April issue of the Plant Disease Reporter.

Potato Viruses S and M: In studies pursued at the University of Wisconsin under Doctors Larson and Walker and continued at Fredericton, R. H. Bagnall has collected considerable information on the potato viruses S and M.

Interveinal mosaic (IVM) is a virus disease of Irish Cobbler and other American varieties. Affected plants show slight stunting and a diffuse interveinal mottle of the leaves. Presence of virus X was confirmed and virus S was revealed in all Irish Cobbler plants whether or not they showed symptoms of IVM. No known strains of potato viruses A, F, or Y were encountered, but a virus designated potato virus M was isolated eventually from Irish Cobbler affected by IVM. Virus M was separated from virus X in the IVM complex by sap transfer to potato seedling U. S. 41956 and from virus S by passage through a selection of Datura metel in which virus M becomes sytemic more rapidly than virus S. Serological antisera were prepared for viruses M, S, and X. Each virus could be specifically identified by this means even when all three were present. Cross-precipitin tests showed that virus S and virus M possess some serological component in common, but this component represents only a small fraction of their respectively antigenic activities. Although these two viruses are closely related present evidence suggests that they are to be regarded as distinct viruses because the differences between them are greater than those between strains of a single virus.

A wide range of hosts was mechanically inoculated with sap extracts containing virus S and virus M respectively. Contrasting symptoms were best seen on Chenopodium album, Datura metel, Nicotiana debneyi, Solanum rostratum, Cyamopsis tetragonoloba, and Vigna sinensis grown at 18 to 20°C. Tomato and eggplant were symptomless hosts of virus M but were immune from virus S. Capsicum annuum, Nicotiana tabacum, and N. glutinosa were immune from both virus S and virus M.

Eighty varieties of potatoes from Canada, Europe, and the United States were tested serologically for the presence of virus S. The great majority of these varieties, all or in part, proved to be infected. This fact indicates that virus S rivals virus X as the most widespread among the potato viruses. Numerous older varieties appear to be entirely infected with both. Varieties free from virus S included Alpha, Jubel, Saco, Sebago, and Voran. Sebago was infected with virus S by grafting but not by sap inoculation. Saco, despite repeated attempts, has not been infected by using either method.

Viruses M, S, and X have also been isolated from Green Mountain potatoes showing leaf-rolling mosaic (LRM), first described by Schultz and Folsom (J. AGR. RESEARCH 25, 43-118, 1923). Interveinal mosaic and leaf-rolling mosaic have been reported from time to time in the United States and Canada and an apparently

similar disease termed "curl" has been reported in Germany. The varieties Fortuna and King Edward reported in Europe to harbour strains of virus S were shown to to contain both virus M and virus S. The isolation of virus M from the King Edward variety was of particular interest for there is now good evidence that virus M is responsible for the "paracrinkle disease", which is latent in King Edward, but which develops symptoms in other varieties grafted with King Edward scions. Nevertheless, little is definitely known of the incidence of potato virus M.

Little is known also concerning varietal resistance towards virus M. The variety Saco, which appears to be immune to viruses S and X and field-immune from virus A, was readily infected with virus M by sap inoculation. This variety was recently used to separate virus M from virus S.

For a detailed account of the work done at the University of Wisconsin the reader is referred to UNIV. WIS. RES. BULL. 198, August, 1956, by R. H. Bagnall, R. H. Larson, and J. C. Walker, or a short paper by the same authors in AM. POTATO J. 33, 271-273, 1956.

I. L. Conners

NEWS FROM NEW SOUTH WALES

Eradicant Treatment for Apple and Pear Scab Control: K. E. Hutton reports further progress in New South Wales with pre-leaf fall spraying with 0·1 per cent. phenyl mercuric chloride for apple and pear scab control. Three small isolated apple orchards which were severely infected during the 1954-5 season were sprayed after harvest in 1955 and in 1956. They received no fungicidal spray during the 1955-6 season or during the 1956-7 season. At the end of the first season (a very bad scab year) each orchard was commercially "clean" but carried slight leaf infection. At the end of the second season (excellent ascospore infection conditions in spring but dry summer and autumn) one orchard showed no scab lesions on fruit or leaves, one showed slight leaf infection on two trees, and in the other a few lightly infected fruit and leaves were detected.

All trees in a small isolated district (Yetholme) of 170 acres of pome fruits, mostly apples, were sprayed with phenyl mercuric chloride in autumn 1956 and the treatment has been repeated in autumn 1957. Minimum spraying schedules were applied during the 1956-7 season by the 40 owners involved, ranging from nil to seven spray applications for the season. All growers reported the best quality fruit they have ever grown and the least scab infection. One grower found 20 lightly infected apples in 800 cases, another found 6 in 1,100 cases and another 24 in 2,000 cases. These growers applied 7, 3, and 4 protective sprays, respectively, during the 1956-7 season.

Present evidence suggests that in some locations it may be possible to eradicate scab from an orchard by this method, while in other locations is may be possible to obtain commercial control of scab by a single annual post-harvest spray. Although the cost of material for this spray is very high there is the economically sound possibility of gaining assured scab control from one spray instead of the uncertain control now being obtained from the 10 or 12, and sometimes more, protective or eradicant-protective sprays required under tableland conditions in N. S. W.

Control of Abacâ (Musa textilis) Mosaic: During November and December 1956 Dr. C. J. Magee visited the Republic of the Philippines to advise the Government on the control of abacâ (Manila hemp) mosaic. The visit was arranged by the Technical Assistance Board of F. A. O., Rome. Prior to the war manila hemp was a virtual monopoly of the Philippine Islands and formed an important segment of their economy. In 1939 abacâ was grown on $\frac{3}{4}$ million acres and exports exceeded one million bales of fibre. During the Japanese occupation the industry declined and has not since made a satisfactory recovery. One of the several causes of this has been the widespread development of mosaic. Progress had been made in the investigation of the disease but difficulty is experienced in deriving disease-free planting stock. Now it appears that the virus which causes mosaic is not Cucumis virus 1 as hitherto thought but one of the "grass mosaic" group and that the occurrence of an interesting form of latent primary infection has rendered difficult the production of disease-free planting stock. The virus seems to be able to remain latent in the intricate corm system of the abacâ plant for up to and exceeding twelve months.

C. J. Magee

NEWS FROM INDIA

Reaction of Wheat Variety Ridley to Black Rust: An Australian wheat variety Ridley has shown very interesting results when tested in the seedling and adult stages at the I.A.R.I. The variety was tested with races 15, 15-C, 21, 21-A, 34, 40, 75, 122 and 194 of black rust and produced with all these races susceptible-type pustules on stem, leaf sheaths and ears, though in the seedling stage it was resistant to all except 15-C and 122.

Rust epiphytotic: During this year a serious outbreak of all the three rusts of wheat was recorded from many parts of India. The attack was particularly severe in Madhya Pradesh, Eastern Uttar Pradesh and Bihar, where at some places losses appear to be as high as 60 per cent.

Mutations induced by ionizing radiations: In the Mycology Division of I.A.R.I., New Delhi, a mutant of Colletotrichum falcatum, the causal organism of the red rot of sugar-cane, has been obtained with the aid of fast neutrons. The mutant forms white spore masses instead of the usual pink ones in culture. In another case, different kinds of branching in the sporangiophores of Phycomyces blakesleeanus, a character which is of considerable taxonomic interest, has been induced by radioactive phosphorus.

Banana Mosaic: Lately, a virus disease affecting banana has been assuming alarming proportions in some districts of the Bombay State. The disease produces characteristic yellow patches of various sizes on leaves of affected plants, which also show extreme dwarfing. Such plants do not bear normally, but if a bunch is produced it is of no commercial value. The virus of banana mosaic had been transmitted by Aphis gossypii, but not by the banana aphis, Pentalonia nigronervosa.

R.S. Vasudeva

Forest Pathology Notes from India

RED SPRUCE: Spruce (Picea morinda) which grows at about 8,000 ft. and above in the Himalayas is a sapwood tree and develops no heartwood. The wood is normally white. Spruce sleepers are floated down the rivers from the hills to the plains where they are in demand. In many areas, some apparently healthy standing trees (d.b.h. 20-30 inches and above) develop a red colour in the central wood both in the roots and stems up to a great height. Sleepers from red spruce sink in water unless air dried for nearly a year. Their transport by river is therefore difficult.

There is no decay associated with red spruce from which, however, a Fusarium has been frequently isolated. In section, hyphae are seen in the wood. It is therefore likely that the Fusarium is the cause of the red stain in spruce. The infection occurs through the roots. The incidence of red spruce with respect to soil, age class of the tree, etc. should be worked out to understand this problem of economic importance.

MYCORRHIZA: Ectotrophic mycorrhiza has been observed in Cedrus deodara (deodar), Picea morinda (spruce), Pinus rozburghii (chir), and Abies pindrow (fir), all Himalayan conifers.

Circumstantial evidence that mycorrhiza is beneficial was obtained from a field observation in R.W.C., PBI, Compt. 1B, Parbatty range, Kulu division, East Punjab during 1955. The area was replanted in 1948 with deodar while chir and spruce were coming up naturally. The plantation which was visited by me in 1955 was not doing well in many places, where the growth was stunted and the plants appeared pale (yellow). The roots of the seedlings in these bad areas developed poor or no mycorrhizal roots, and this was believed to be the cause of the poor plantation in the absence of other evidence.

It thus appears that serious fires may kill not only the standing crop but also the beneficial soil microflora, including mycorrhizal fungi. Successful afforestation of such areas depends on the return of the normal soil microflora.

B.K. Bakshi

WEST INDIAN NOTES

HELICOPTER SPRAYING OF BANANAS

Recently an experiment was carried out in Jamaica on the control of Leaf Spot or Sigatoka disease (Mycosphaerella musicola) of Lacatan bananas to compare the effect of applications of Orchard Spray Oil applied with (a) a Hiller helicopter by Messrs. Fison Airwork Ltd. and (b) a mechanical knapsack mist-spraying machine (Motoblo).

Two contiguous 4 acre plots of ratoon bananas were sprayed, each at the rate of 2 gallons of Esso Orchard Spray Oil per acre, while a smaller ½ acre plot nearby was left unsprayed as a control. The figures given below speak for themselves.

The fungistatic (eradicant) effect of the oil on the fungus in the tissues can be appreciated by realising that over the same period of time little or no difference could be expected between plants sprayed and unsprayed with Bordeaux mixture. Bordeaux only prevents infection of the young leaves whereas the oil has also an immediate retarding effect on the development of the fungus within the previously infected foliage, especially when applied to the undersurface of the leaves. These surfaces are reached by the spray from a helicopter owing to the turbulence created within the crop at the time of spraying.

This experiment was carried out on bananas heavily infected by ascospores. It will be interesting to know whether oil spraying is equally effective against water-borne, conidial infection, e.g. on the Gros Michel bananas being sprayed by helicopter in Ecuador.

Helicopter Oil Spraying Experiment
Sprayed Oct. 11th, Oct. 25th, Nov. 8th, Nov. 22nd
Average per cent. Area of Each Leaf Killed by Leaf Spot*

Leaf No.	Control ½ acre		Helicopter 5 acres		Mechanical Knapsack Mistsprayer 5 acres	
	Start Oct. 11	End Dec. 16	Start Oct. 11	End Dec. 16	Start Oct. 11	End Dec. 16
1st	0·0	0·0	0·0	0·0	0·0	0·0
2nd	0·0	0·0	0·0	0·0	0·0	0·0
3rd	2·8	3·1	5·4	2·0	4·6	1·5
4th	16·5	22·2	40·3	5·1	24·6	6·0
5th	46·0	37·8	64·1	3·8	42·3	4·3
6th	63·8	57·7	82·9	9·8	58·9	5·0

* Records taken on every 4th plant of every 4th row, except in Control plot on every 3rd plant in every other row.

Average per cent. Area Killed by Leaf Spot of First Six Leaves

		ROW 1	2	3	4	5	6	7	8	9	10
Control	Oct. 11, 1956	17·3	20·9	25·8	22·0	-	-	-	-	-	-
	Dec. 16, 1956	19·3	23·9	19·0	28·4	-	-	-	-	-	-
Helicopter	Oct. 11, 1956	21·2	34·1	34·2	43·0	38·7	34·7	29·7	28·4	26·8	30·6
	Dec. 16, 1956	4·1	4·4	44·1	4·5	4·9	5·8	3·8	2·8	2·6	3·5
Knapsack Mistblower	Oct. 11, 1956	16·9	17·6	22·8	24·6	25·4	18·7	25·1	23·0	-	-
	Dec. 16, 1956	3·4	4·7	3·1	2·4	2·6	2·7	2·4	1·7	-	-

Banana Board, Kingston, Jamaica. R. Leach

CONTROL ENVIRONMENT IN CROP EXPERIMENTATION

The 4th Easter School in Agricultural Science, held at the University of Nottingham School of Agriculture, Sutton Bonington, from April 15th to 17th, 1957, took the form of a symposium on The Control of Environment in Crop Experimentation. In recent years study of the relationship between the plant and the factors of its environment has been greatly facilitated owing to the skill of the lighting and heating engineers. By modifying natural conditions in the glasshouse or by growing plants entirely in artificial conditions in the growth room or growth cabinet it is possible to vary independently such factors as temperature, intensity and quality of light, and the duration of the light and dark periods. An attendance of 200 demonstrated the wide interest at present being shown in this approach and the techniques involved.

The opening paper by Prof. S.J. Wellensiek, of Wageningen, emphasized the need for this type of enquiry, and surveyed the field of The Plant and Its Environment. The concepts of diurnal and long term thermoperiodism were discussed together with the relationships between photosynthetic light and temperature and between photoperiodism and temperature. Recent work at Wageningen on the groundnut has suggested that diurnal thermoperiodic requirements may differ between temperate and tropical plants.

Dr. W.W. Schwabe, of the Research Institute of Plant Physiology, in a paper entitled The Study of Plant Development in Controlled Environments emphasized that plant development is determined by the rates at which different processes are carried out. Environmental factors can affect differentially the rates of primordial initiation, leaf expansion, and other plant processes, resulting in changes in morphogenetical characters.

Prof. E.C. Wassink discussed The Study of Plant Growth in Controlled Environments as exemplified by work at the Laboratory of Plant Physiological Research at Wageningen in the last five to ten years. These included the conditions for flowering of bulbous irises; the relations between root growth rate and the conditions to which the shoot is exposed in tree seedlings; and the relationship between the heading of lettuce and morphological characters such as leaf shape.

Controlled Environments in the Study of Plant Genetics was discussed by Prof. P.T. Thomas, of Aberystwyth, who pointed to the need for greater collaboration between the plant geneticist and the plant physiologist.

A joint paper by Dr. Daphne Vince and Prof. R.H. Stoughton, of Reading, dealing with Artificial Light in Plant Experimental Work, classified the types of lamp at present available and stressed the dangers and precautions connected with choice of lamps. The effect of light sources of differing spectral composition on plant growth were demonstrated. Prof. Stoughton considered that too many institutions were endeavouring to install equipment on too precise and elaborate a scale and suggested that work requiring a high degree of precision would be better undertaken by one central body for which special funds should be made available.

Dr. J.P. Hudson, Head of the Department of Horticulture at Sutton Bonington and organizer of the Easter School, surveyed The Study of Plant Responses to Water, and demonstrated that the concept of definable and reproducible water-regimes offered a valuable means of studying the relationships between plant, soil, and water. The problems connected with the availability of moisture over the range of soil water content from wilting point to field capacity were discussed together with the theory of "equal availability" in the light of results of experimental work at Sutton Bonington.

Wind as a Factor in Plant Growth was the subject of a paper by Dr. F.H. Whitehead, of Oxford, who gave details of an investigation of natural alpine communities and demonstrated a correlation between yield and other growth criteria and shelter from wind.

Mr. W.J.C. Lawrence, of the John Innes Horticultural Institution, had many interesting suggestions to make on The Glasshouse as an Environment for Plant Experiments, including the possibility of end-to-end ventilation. How to reduce gradients in the levels of the various factors in both space and time was the central problem.

Two evenings were devoted to descriptions of installations for the control of plant environment, including the so-called "phytotrons" at the Earhart Plant Research Laboratory, Pasadena, California, and at the University of Liège, described

and illustrated by Dr. A.M.M. Berrie, of Glasgow University. Details of growth rooms at the John Innes Horticultural Institution, the Department of Agricultural Botany at Aberystwyth, and the Electrical Field Research Station at Reading, and of growth cabinets at the University of Cambridge Botany School, Scottish Horticultural Research Institute, and the Research Institute of Plant Physiology, London, were described by members of the institutions concerned.

Equipment for special purposes was also described, such as automatically controlled daylength covers, wind tunnels, equipment for the study of effect of intensity and quality of light, and for the prevention of undue rise of temperature in glasshouses.

The costly nature of controlled environment installations was an ever recurrent theme, and its variation, the impecunious nature of research establishments, was even more feelingly expressed. Nevertheless, it was demonstrated that ingenuity could do much to redress financial shortcomings, and some degree of "making do" was perhaps inevitable. The engineer, as notably pointed out by Mr. B.W. Payne, of Refrigeration Ltd., would do his utmost to produce the closest control possible, but the experimenter must clearly decide just how fine a degree of precision is really necessary for the purposes which he has in mind. The engineer's approach was thoroughly presented by Mr. L.G. Morris, of the National Institute of Agricultural Engineering, on the final morning.

If, towards the end of this high pressured 48-hour meeting members were in danger of considering the growth room an end in itself, they would have been effectively brought back into the field by Prof. A.H. Bunting, of Reading, in the final paper Agronomical Aspects of Environmental Control. This stimulating and penetrating survey of the future possibilities of increasing crop yields typified the good sense and good humour which was characteristic of a very enjoyable and lively meeting. The proceedings will be published in full by Messrs. Butterworths Scientific Publications later in the year.

University of Nottingham Winifred M. Dullforce

A PLASTIC SEAL FOR CULTURE TUBES AND FLASKS

Preserving agar medium, even for a short period under ordinary laboratory conditions, presents some problems — the medium often gets dried or contaminated in a short time. At least two methods have been developed in the past to overcome these drawbacks (Eddins, A.H. (1948) - PHYTOPATHOLOGY, 38, 578; Gupta, B.M. - CURR.SCI., 16, 94-95). A simple technique of sealing culture tubes and flasks with 'alkathene' film (the I.C.I. brand of polythene) has now been found very satisfactory and is described here.

Square pieces of 'alkathene' film (gauge 200 or 250), enough to cover and extend slightly over the mouth of the culture tube or flask, are sterilized in alcohol. The cotton wool plug is removed under asceptic conditions, the mouth of the tube or flask flamed, and while still hot a sterilized 'alkathene' piece is gently placed over it, and the part of the film projecting outwards is gently pressed down the wall of the tube or flask. The film melts when it comes into contact with the hot glass surface and sticks to it, making an effecting seal. (see fig.)

In our experience, agar medium in such 'alkathene' sealed tubes and flasks kept very well over a period of four months with no microbial infection or infestation by mites. It is thus possible to preserve live fungal cultures as the 'alkathene' seal permits gaseous exchange.

K.S. Venkataramani

UPASI Tea Experiment Station,
Devarshola Post, The Nilgiris,
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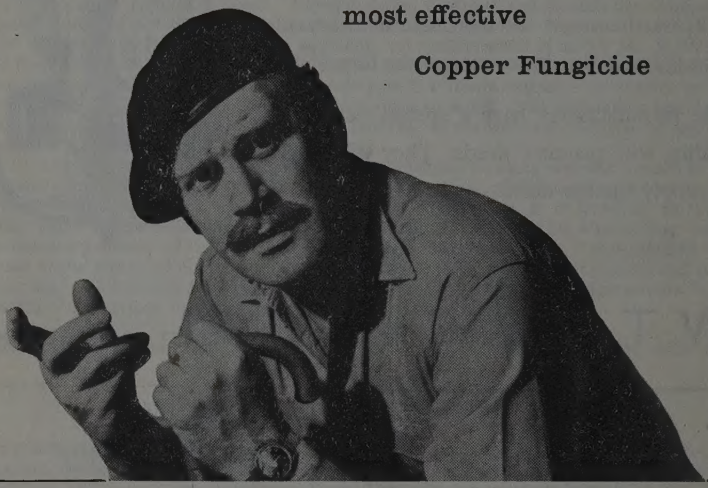

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